**Earth Sciences 3340a/b Watershed Hydrology - Fall 2019**

Description: Occurrence, movement, and behavior of water in the hydrologic cycle. The development of quantitative representations of hydrologic processes (e.g. precipitation, evapotranspiration, runoff, infiltration and unsaturated flow, saturated flow, surface flow). Analysis of stream response hydrographs. Statistical models of predicting flood responses and water resource management.

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Prerequisites: Any 1.0 course equivalent at the 1000 level from Calculus, Mathematics, Applied Mathematics, or Statistical Sciences, or the former Linear Algebra 1600A/B.

- *Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.*
- *Accessibility Statement: Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.*
- *Students who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help.*

Text: Physical Hydrology 3rd Edition, S. Lawrence Dingman, ISBN 978-1-4786-1118-9, 2015 Waveland Press. You will absolutely require the textbook as lectures and lab work directly with material / figures from the text that are not reproduced in the online notes. The lecture notes and lectures will guide you into what sections (and what 'depth') you are required to understand. This text is routinely used in practice. As such it is quite extensive and goes into much greater depth on many topics than is required for this course.

Lectures / Labs: 2 lecture hours and 2 laboratory hours per week
lectures – AHB-1B06; Thursday 9:30 to 11:20 a.m.
labs – Thurs. 1:30 p.m. to 3:20 a.m. 0184 & 0182 B&G
Thurs. 3:30 p.m. to 5:20 p.m. 0184 & 0182 B&G

Lecture Material: The text portion of the lecture presentation slides will be made available on OWL. Figures used in the lectures come from the textbook, various web links, government sources, or various consulting reports. Text figures, or material with disclosure issues (e.g. consulting reports), will not be posted on OWL. You are expected to attend lectures and make additional notes to augment the text provided. The main purpose of the lectures is to help you understand key hydrological processes and techniques used to quantify these processes. The labs apply the techniques. Case studies / consulting reports give you the real-world application of these techniques.

Assignments: Assignments are directly tied to lecture topics; usually a given lab assignment involves material discussed during the previous week(s) in lecture. Help with assignments and some lecture material on assignments will be given during laboratory session. Assignments will be available on OWL along with lecture notes. Many of the exercises will involve data collection, analysis, and interpretation using programs such as MS Excel and Surfer. Any assignments handed in past the due date will be subject to a penalty of 20% per late day (if you have exceptional circumstances contact Dr. Schincariol prior to due date via email). NOTE: The majority of marks for questions are given for problem setup, assumptions, solution approach, and proper use of significant figures and units. Simply writing down a formula (or providing an Excel output) and giving the answer, even if correct, will not result in full marks. NOTE: 20% of each assignment grade is for proper layout and organization, neatness, and significant figures / statement of uncertainty.

- *If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be*

*obtained from the Dean's Office immediately. For further information please see the Policy on Accommodation for Medical Illness at: www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf*

Marking Scheme:

| | | |
|---|---|---|
| Lab Assignments | 27% | (9 labs each worth 3%) |
| Midterm* (2 hrs) | 36.5% | Oct. 17, 9:30 a.m. to 11:20 a.m. (in-class); lectures up to and including Oct. 10; labs 1, 2, 3, 4. |
| Final Exam* (2 hrs) | 36.5% | lectures Oct. 24 to Dec. 05; labs 5, 6, 7, 8, 9. |

* Exams & tests will be closed book (definitions; short answer; calculations). Bring pencil, ruler, eraser, and basic calculator (basic math & geometry functions; but no extensive non-volatile memory capability). *A calculator is to be used for calculations only and not storage of information - any recall of such stored information will be considered a scholastic offense (cheating). No other electronic devices will be allowed. Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.*

You will be responsible for both lab problems and lecture material on term tests and final exam. It is highly recommended you attend all lectures and labs.

**Learning Outcomes**

Upon successful completion of this course students will be able to:

- Apply quantitative skills to assess and evaluate all components of the hydrologic cycle including precipitation, evapotranspiration, surface water flow, unsaturated zone flow, and ground water flow.
- Framework calculations of hydrologic quantities, and water balances, within their respective data limitations, including model error and measurement error, both spatially and temporally.
- Delineate watersheds topographically and evaluate how topographic and subsurface hydrogeology processes affect watershed divides and basins.
- Assess current and historical precipitation patterns from online radar, satellite, and ground based measurements.
- Assess historical and 'realtime' streamflow hydrographs both online and in the field through application of current meter, float, and dilution gaging methods.
- Comparative calculation of evapotranspiration through evaporation pan, water balance, FAO Penman-Monteith, and Thornthwaite and Mather models.
- Measure field saturated hydraulic conductivity and matric flux potential using the Guelph permeameter.
- Measure unsaturated hydraulic conductivity using a tension infiltrometer.
- Construct potentiometric maps and quantify ground water flow vectors and velocities.
- Quantify event and stream base flows using runoff models.

**Course Outline**

| Main Lecture Topics | Labs |
|---|---|
| Introduction to the Hydrologic Sciences | |
| Hydrologic cycle, water budgets and watersheds | 1, 2 |
| Precipitation – processes, measurement, spatial and temporal variability | 3 |
| Evapotranspiration – processes, measurement, models | 4 |
| Open Channel Hydraulics – measuring stream discharge | 5, 6 |
| Unsaturated Flow – properties of soils, infiltration, storage, flow | 7 |
| Ground Water Flow – flow, surface water – ground water interactions, balances | 8 |
| Stream Response to Water Input Events – mechanisms producing event response, rainfall-runoff models | 9 |

**Laboratory Schedule** – labs are due at the start of the next lab (i.e. lab 1 due Sept. 19) unless noted otherwise.

| *Date* | |
|---|---|
| Sept. 12 | Lab 1 – Watershed Delineation |
| Sept. 19 | Lab 2 – Water Budgets |
| Sept. 26 | Lab 3 – Precipitation |
| Oct. 3 | Lab 4 – Evapotranspiration |
| Oct. 10 | Lab 5 – Streamflow Measurements (be prepared to go 'in-field' rain or shine) |
| Oct. 17 | Lab 6 – Streamflow Calculations OR Measurements if delay due to high water |
| Oct. 24 | Lab 6 – Streamflow Calculations IF delayed / lab off if not. |
| Oct. 31 | Lab 7 – Unsaturated Flow Measurements & Characteristic Curves |
| Nov. 7 | No Lab – Fall Reading Week |
| Nov. 14 | Lab 8 – Ground Water Recharge |
| Nov. 21 | Lab 9 – Ground Water Flow |

**Notes:**

1. You are expected to attend all labs and use the lab periods to work through the problems. T.A.'s will take attendance during the labs. T.A.'s have limited availability after the lab sessions; those who do not attend the labs should not expect T.A. assistance outside lab time.
2. Labs 5 and 7 are outdoor labs. Come prepared to work outside and dressed for the weather. We work rain or shine just like in the real world!